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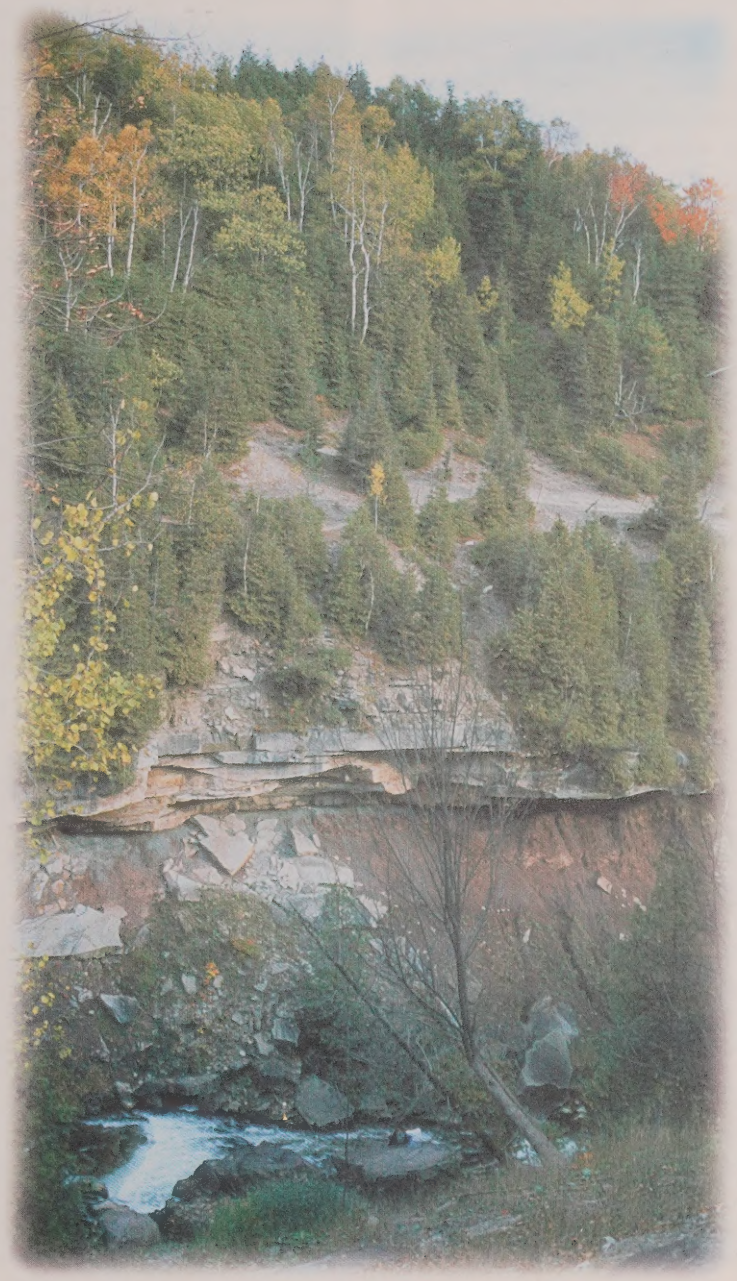

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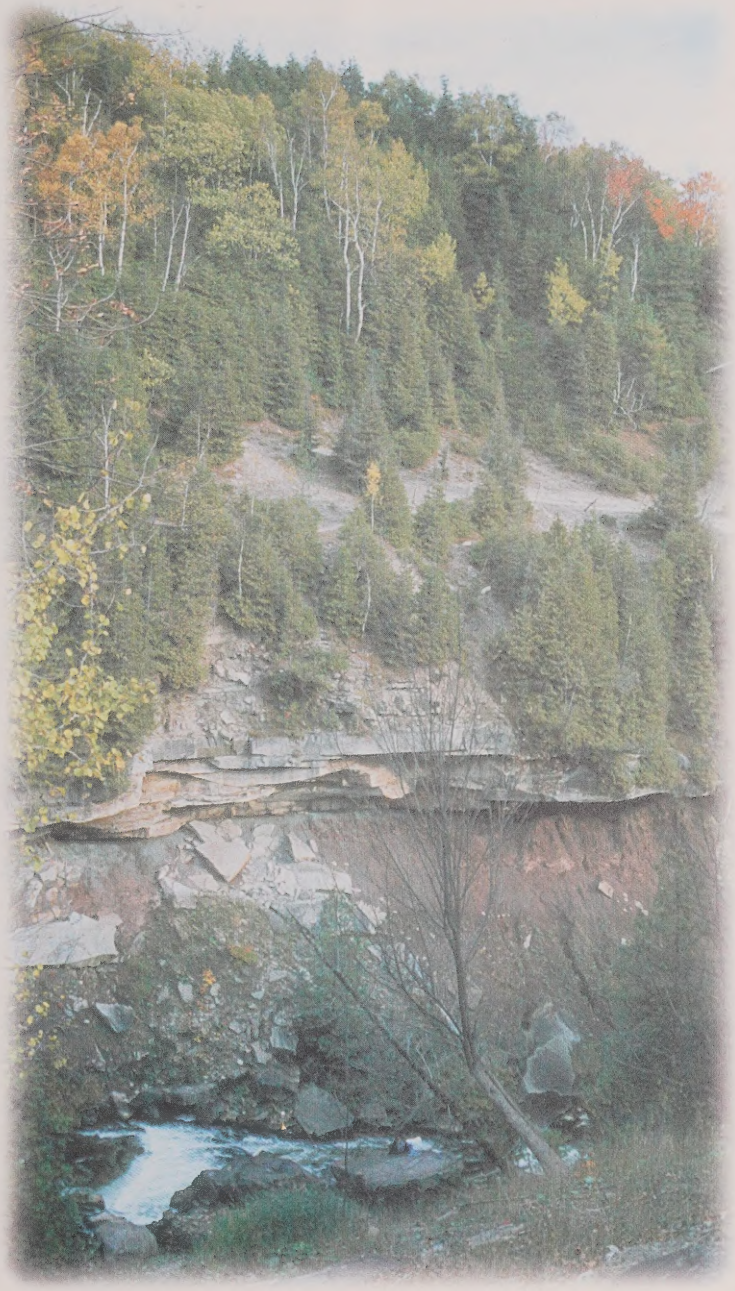
Groundwater:
Our Hidden Treasure

How does one place a monetary value on a resource whose presence touches, directly and indirectly, almost every aspect of our lives? To put it simply, groundwater is a priceless resource in Ontario. Its slow, but constant underground movement transports potable water over large geographic areas, ultimately supplying over one third of the province with its primary drinking supply. For many communities, groundwater sustains domestic, industrial, commercial, and institutional water needs, as well as agricultural water uses such as irrigation and livestock watering. The capacity of Ontario's groundwater supply to meet growing future demands has become a major concern.

Attempting to quantify the socioeconomic value of the resource may help planners make better decisions about its management and use. Calculating the true socioeconomic value however is a complex matter which involves accounting for its direct and indirect utility in the lives of the people who benefit from it.

Groundwater is continually recharged when precipitation infiltrates porous land. As water seeps down to aquifers — underground layers that store and move groundwater — many pollutants and impurities it picks up on the surface are filtered out. However, these recharge and purification capacities are vulnerable as they depend on the type



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and intensity of land-use in the watershed. Contamination of groundwater is a serious problem. Because it is so expensive to clean up a contaminated aquifer, it is preferable by far to prevent contamination from happening in the first place.

Groundwater supplies the baseflow to most streams and rivers. Baseflow is the low flow that keeps a waterway running during periods of dry weather. Because it originates far below the surface, groundwater baseflow is cool, helping to make streams hospitable for cool-water species of fish and other life forms. Water stored underground also helps maintain wetlands, and wherever it supplies water to the surface it provides sustenance for all types of wildlife. Groundwater ultimately helps to support tourism and recreational activities like boating, hunting, fishing and swimming.

Diminished availability of clean groundwater can lead not only to economic problems, but also create significant environmental consequences. From a geological perspective, groundwater maintains soil moisture and ground stability. Over-consumption can lead to *subsidence*, a situation which occurs when the volume of groundwater has been reduced to such a point that the earth it supports collapses. This has occurred with devastating physical, social and economic results in places such as Mexico City, and the cities of Houston and Galveston, Texas.

When groundwater is not readily available to a community's residents, other water sources have to be found. This will mean real costs to municipalities to obtain water from alternate sources. In order to calculate the economic value of having the groundwater accessible, a "consumer surplus value" can be used. This is an estimate of the money that becomes available if groundwater does not have to be purchased from another, higher cost source.

Quantifying groundwater's ecological and intrinsic value however is a little more complicated. It requires recognizing and accounting for the holistic quality of the ecosystem. This leads one to appreciate that groundwater's true social, ecological and economic utility is not measurable in dollars alone, but ultimately has a worth well beyond consumer surplus values.

It is important to recognize that while we benefit from the role groundwater plays in our lives, our daily activities have the potential to seriously threaten both the quality and quantity of present and future groundwater resources. Weighing the benefits of short term economic growth against long term ecological and economic sustainability should help decision-makers make sound planning and management choices.

SUSTAINABILITY IN CALEDON, ONTARIO

Caledon is a town of nearly 40 000 situated at the junction of the Oak Ridges Moraine and the Niagara Escarpment, two geological remnants of the last ice age. These two elevated landforms make the area a storehouse for large quantities of groundwater in underground deposits of sand, gravel and rock. The town depends on these reserves as its primary source of potable water.

By virtue of its location in a 700 square kilometre area north of Brampton, the Town of Caledon lies within the headwaters of four surface watersheds. The Humber and Credit River Watersheds, which encompass most of the town, flow south through Toronto and surrounding areas to Lake Ontario. The area also includes small parts of the headwaters for the Nottawasaga and Holland Rivers. These water courses flow north to Georgian Bay and Lake Simcoe.

Caledon is composed of more than 20 small settlement areas, four of which are expected to face the bulk of increasing development pressures. Over the next 15 years, it is anticipated that the town's population will increase by another 22 000 over the next 25 years its population will double.

Concerns about whether the town's groundwater supplies will be sufficient to handle growing demands have led to a number of studies to better understand the groundwater system. Researchers are trying to determine how much water can be withdrawn sustainably from local aquifers.

ECONOMIC VALUE OF GROUNDWATER

A recent Environment Canada study put a dollar value on Caledon's groundwater to demonstrate the economic reasons for wise use and planning of groundwater resources.

In economic theory, the monetary value of a water resource is somewhere between its use value (the value reflected by the way humans put the resource to use) and the value established through the cost of obtaining it from an alternative source. The Caledon study estimated the cost of replacing the groundwater source with the next best alternative. This estimate took into account consumers' willingness to pay, since it is assumed that groundwater has more value than that reflected in its current price. There is a "surplus" value, which is what a consumer would be willing to pay over and above the current price rather than do without water.

In the case of Caledon, replacement water for some settlement areas would likely come from extensions to the Region of Peel's system, which pipes water from Lake Ontario. However, some more sparsely populated areas would probably have water transported by truck. An alternative drinking water supply could cost considerably more than the average of 40 cents per cubic metre that residents and businesses paid in 1995. It is estimated that the total costs of these services — averaged among all users — would push the water price up to $5.37 per cubic metre (m3).

After establishing the price per cubic metre, the yearly value of Caledon's groundwater was calculated based on a range of potential water prices, starting at $0.50/m3 — slightly above the current price — and ranging to $5.37/m3. All direct and indirect water users were included, and differences in their willingness to pay was taken into account.

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The resulting calculations put the annual 1995 value (measured as consumer surplus) of Caledon's groundwater somewhere between $9.6 million and $33 million (see Table 1). This translates to between $244 and $841 per person per year, or between $732 and $2 523 per year in a three-person household.

This means that if Caledon were to lose the use of all of its groundwater today, it would cost residents up to $33 million in consumer surplus per year to replace it with the next best alternative water source.

In other words, this range of figures represents the amount of economic value that groundwater brings to the Town of Caledon — the amount that Caledon's groundwater was worth in 1995.

Table 1
Total Annual Use Value of Groundwater in the Town of Caledon, 1995

	Lower Value ($) at $0.50 per m^3	Upper Value ($) at $5.37 per m^3
Direct Uses		
Domestic Water Use	2,562,757	14,152,067
ICI* Water Use	3,969,929	13,010,229
Agricultural Water Use	1,070,118	2,080,237
Subtotals	7,602,804	29,242,533
Indirect Uses		
Wastewater Treatment	644,263	2,469,982
Recreation	1,326,956	1,326,956
Subtotals	1,971,219	3,796,938
Total	**9,574,023**	**33,039,471**

* ICI: Industrial, commercial and institutional

Source: An Assessment of the Ecological and Economic Value of Groundwater: Town of Caledon Case Study, Marg Troyak, October, 1996

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USE VALUE INCREASES WITH POPULATION GROWTH

Table 2
Total Annual Use Value of Groundwater in the Town of Caledon Assuming Increased Water Use Due to Population Growth

	Lower Value ($) at $0.50 per m^3	Upper Value ($) at $5.37 per m^3
Direct Uses		
Domestic Water Use	4,069,961	22,788,782
ICI* Water Use	6,210,371	20,352,590
Agricultural Water Use	1,070,118	2,080,237
Subtotals	11,350,450	45,221,609
Indirect Uses		
Wastewater Treatment	1,134,416	4,263,046
Recreation	2,070,052	2,070,052
Subtotals	3,204,468	6,333,098
Total	**14,554,918**	**51,554,707**

* ICI: Industrial, commercial and institutional
Source: An Assessment of the Ecological and Economic Value of Groundwater: Town of Caledon Case Study, Marg Troyak, October, 1996

Since the population of Caledon is expected to grow by 22 000, or 56%, within the next 15 years, the annual value of the town's groundwater should rise accordingly. The figures in Table 2 show that if the town's population grows to more than 60 000 by 2011 and water use increases, the annual value of the groundwater resource will be between $14.5 million and $51.6 million.

If used and managed sustainably, groundwater resources should be available for an indefinite period.

If the annual value of groundwater stays the same for the next 50 years, the "total present value" is the 1995 annual value multiplied by 50. However, since the value of a dollar today is likely to be less 50 years from now, the total present value must take into account this "discount".

Thus, the total present value of Caledon's groundwater is calculated based on various "discount rates" which allow for a declining value of money over time.

WORTH TO FUTURE GENERATIONS

In Table 3, the total present value of groundwater is estimated over time spans of 50 years, 100 years and 210 years (seven generations). [The total present value of water over a period of 210 years is based upon the First Nations philosophy of considering the impacts that actions taken today will have for seven generations into the future. Obviously, these numbers are hypothetical and cannot be taken literally, but they help illustrate the long term asset values that exist in unseen underground aquifers, and they help demonstrate how actions of today affect the lives of the future.]

The table shows that the "present value" of Caledon's groundwater use over the next 50 years is currently worth between $374.5 million and $1.3 billion at a discount rate of 3%. Present value is an estimate of the capital/asset value of the groundwater. This is the amount of money that would have to be invested in a lump sum today, at 3% interest, in order to yield an annual income sufficient to pay for the present and expected population's use of ground water for 50 years. It is the estimated value they would lose over the next 50 years if they had to replace the groundwater today from the next best available source.

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Table 3
Total Present Value of Groundwater in the Town of Caledon Based on 1995 Use Value and Assuming Increased Water Use ($ millions 1995)

	1% discount rate	3% discount rate	4% discount rate
Over a 50 year lifetime			
Lower Value*	570.5	374.5	265.7
Upper Value**	2,020.7	1,326.5	941.2
Over a 100 year lifetime			
Lower Value	917.4	459.9	288.9
Upper Value	3,249.4	1,629.1	1,023.3
Over 7 Generations (210 Years)			
Lower Value	1,275.4	484.2	291.1
Upper Value	4,517.5	1,715.0	1,031.1

* Lower Value is based on $0.50 per m^3
** Upper Value is based on $5.37 per m^3

Source: An Assessment of the Ecological and Economic Value of Groundwater: Town of Caledon Case Study, Marg Troyak, October, 1996

This example should not be taken literally. It is meant to demonstrate how much clean, accessible water supplies can be worth to present and future generations.

The underground water supplies that serve the Town of Caledon are not confined within the town's boundaries. They serve other geographic areas as well. As the water moves through soils and rock underground, it carries the effects of land and water use elsewhere.

For example, the Humber River watershed alone supports a population of 485 000. The health of this watershed is at least partially affected by the quantity and quality of Caledon's groundwater since it contributes to the Humber River's baseflow. The same is true in the Credit River, Nottawasaga River and Holland River watersheds.

Since a number of communities near Caledon (including Halton Hills, Erin, Orangeville, New Tecumseh and King) also use groundwater, it is estimated that more than 100 000 people in areas adjacent to the Town of Caledon rely on this water resource. If groundwater was worth up to $33 million per year to the nearly 40 000 residents of Caledon in 1995, it must be worth still more to the 100 000 people who live nearby and rely on the same type of water supply today.

Of course, the value of a readily accessible water supply that nurtures both humans and their surrounding environment cannot be measured in dollars alone; nor can its value to

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future generations. The dollar estimates of water's value given here serve only to make the point that even if measured solely in economic terms, our groundwater resources have tremendous value which is too often overlooked.

It should be self-evident, however, that groundwater is truly priceless. As use pressures become more and more insistent, greater care must be taken to manage this resource in a way that sustains not only this generation but generations to come. We need to practice the wise use of water, and be willing to pay the price needed to protect and sustain this most vital of our daily needs.

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The information herein is adapted from: Troyak, Marg. (October, 1996), An Assessment of the Ecological and Economic Value of Groundwater: Town of Caledon Case Study, prepared for Environment Canada.

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